

partial rotations, as in the camphorsulphonate of menthol (Tschugaëff). It may also be produced by an absorption-band in the visible spectrum (Cotton's phenomenon), or, as R. W. Wood has pointed out, by a band in the infra-red region. The view that anomalous rotatory dispersion is usually caused by the presence of two species of optically active molecules in the liquid was adopted by Armstrong, Grossman, Pickard, and other speakers; in support of the same view, it was stated in the discussion that nitrocamphor, which exists in two isodynamic forms, gives anomalous rotatory dispersion in acetone, and that ethyl tartrate may be fractionated into portions which differ very widely in their rotatory power for violet light, although the differences are small when green or yellow light is used.

LIZARD VENOM.¹

THE results of a comprehensive study of the poison of *Heloderma*, undertaken by several observers, under the direction of Prof. Leo Loeb, at the laboratory for experimental pathology, University of Pennsylvania, are published by the Carnegie Institution of Washington in the volume before us.

Heloderma, or the Gila monster, is a lizard attaining the length of 2 or 3 ft., which inhabits the dry regions of Mexico and Arizona. It is of alarming appearance, and regarded by the natives with the utmost dread, although the results of a bite from this reptile are not very serious to man. The two species of the genus are peculiar in that they are the only reptiles other than snakes which possess poison glands in relation to some of their teeth. Unlike the poison glands of snakes, those of *Heloderma* are situated in the lower jaw, and consist of four independent sacs on each side, which open into separate cup-like depressions of the mucous membrane just external to the anterior mandibular teeth. When the jaw is closed the corresponding teeth project into these depressions and thus both upper and lower sets become bathed with the secretion.

The first article contains a good account of the anatomy and histology of the poison gland, and is followed by one on the histological changes in the gland after stimulation by pilocarpine. Then follow papers on the general properties and action of the venom and on some experiments in immunisation. The general lines followed in these studies are those previously traversed by various observers with snake-poisons, with which *Heloderma* venom has many similarities. The venom is an albuminous fluid, but the albumen can be coagulated by boiling without destroying the toxic principle. The latter is, however, carried down in the precipitate, to which it apparently adheres. This toxin seems, in fact, to adhere to almost any kind of fine precipitate, and this property has led to difficulty in all attempts to separate the essential poison.

The main poisonous constituent of the venom is a neurotoxin, and death is caused by gradual paralysis and ultimate cessation of respiration. From experiments upon isolated strips of cardiac muscle, the heart does not seem to be directly affected and the fall of blood pressure following the injection of the venom is presumably due to paralysis of the vasomotor centres. The nerve cells of animals killed by the venom show chromatolytic changes similar to those observed by Kilvington and Lamb and Hunter in snake poisoning. The venom has no influence on the coagulation of blood, nor does it produce hæmorrhages. It does not itself hæmolyse blood corpuscles, but, if mixed

with lecithin it gives rise to a hæmolytic substance. This, as has been shown to be the case with cobra venom, is presumably due to the action of the lipase it contains upon the lecithin. The subcutaneous injection of subminimal lethal doses is followed by a considerable but temporary leucocytosis. Admixture of the venom with leucocytes and staphylococci does not hinder phagocytosis.

The memoir concludes with an account of attempts to separate an active principle from the venom, using the methods by which Faust obtained a non-nitrogenous active body in the case of cobra and crotalus venoms. These methods proved to be unsuitable, but by dissolving the venom in glacial acetic acid and precipitating, first with weak alcohol and then with stronger alcohols, and ultimately with ether, it was found that the successive precipitates with alcohol contained less protein and more active substance, and that the final precipitate with ether was protein free, but very active.

The above short *résumé* gives some idea of the extent of these researches, although a number of papers included in the volume, of less general interest, have not been referred to.

The work seems to have been carefully planned and performed, but the statements about snake venoms are occasionally inaccurate, as, for instance, the affirmation on p. 56 that the venoms of *Hoplocephalus* and *Pseudechis* may be heated without injury, and on p. 60, that the "venom of *Viperidæ*" does not pass through a Chamberland filter.

C. J. MARTIN.

CHINESE PALÆONTOLOGY.¹

THE volume before us contains the palæontological results of the Carnegie expedition to China in 1903-4, and is an important contribution to our knowledge of the Palæozoic faunas of eastern Asia. The principal memoir is by Dr. Walcott, and deals with the Cambrian fossils which were found in large numbers. A total of sixty-three genera and 245 species are described and figured, and of these thirty-six genera and 175 species are trilobites (including five genera peculiar to China) and thirteen genera and thirty-six species are brachiopods. The oldest fossiliferous rocks are referred to the upper part of the Lower Cambrian and contain the *Redlichia* fauna, so that we are now acquainted with this fauna from Shantung, Yun-nan, Spiti, and western and southern Australia, as well as from the Salt Range where it was first found. It is, however, from the Middle Cambrian that the richest and most varied fauna was obtained in the Chinese provinces of Shantung, Shen-si, Shan-si, and in Manchuria, as was the case in the central Himalayas. A rapid process of evolution under new conditions of environment was originated at this period, accompanied by the more or less complete isolation of parts of the marine area, leading to the formation of local faunas. But on the whole the affinities of the Asiatic Cambrian fauna prove to be with the Cordilleran Province of western North America, and with the Upper Mississippian Province of the United States rather than with Europe. This is emphasised by the absence of the genus *Paradoxides* in western North America, China, and India, though other genera connect these areas with the Atlantic Province. In the Upper Cambrian a similar relationship is noticeable. From the evidence now available Dr. Walcott recognises three faunal provinces in Asia

¹ "The Venom of *Heloderma*." By Leo Loeb, with the collaboration of a number of workers. Pp. vi+244. (Washington: Carnegie Institution of Washington, 1913.)

¹ "Research in China." Vol. iii., The Cambrian Faunas of China, by C. D. Walcott; A Report on Ordovician Fossils Collected in Eastern Asia in 1903-4, by S. Weller; A Report on Upper Palæozoic Fossils Collected in China in 1903-4, by H. Girty. Pp. vi+375+29 plates. (Washington: Carnegie Institution of Washington, 1913.)

in Cambrian times, and these he terms respectively the Shantung Province (including Manchuria and Shan-si), the Punjab Province (including Yun-nan), and the Siberian Province.

Passing to the description of the new genera and species from China, we cannot help regretting that there is a general absence of individual comparison of the new forms with previously established or well-known species from other lands. It would have been especially valuable to have had their affinities discussed by Dr. Walcott, with his ripe experience and world-wide knowledge of Cambrian fossils. He indeed expresses the opinion that the excellent illustrations of the new species will enable other investigators to pursue such a study as occasion requires; but no plates or figures, however good, can remedy such a defect in the original descriptions, and this omission robs the memoir of much of its value.

The Ordovician fossils described in the second section by Dr. Weller, have been obtained partly from Shantung and partly from Ssi-ch'uan. The former are very poor and few in number, and no specific determinations were found possible, but their stratigraphical horizon is believed to be Middle Ordovician. The fossils from eastern Ssi-ch'uan are quite different in character and in much better preservation. They were obtained from a thick limestone resting conformably on the Cambrian, and consist chiefly of brachiopods and trilobites, some species of which were described in 1901 by Martelli from Shen-si. Richtigofen's Ordovician fossils from northern Ssi-ch'uan, collected more than thirty years ago, are regarded as indicating the same geological horizon which Dr. Weller correlates with the Mohawkian (Middle Ordovician) of North America. The fossiliferous Ordovician beds of the central Himalayas, to which he makes no reference, have been regarded as of the same age. There is no similarity to the Ordovician faunas of eastern Yun-nan and Tonkin or of the Northern Shan States, but some species appear comparable or closely allied to Spiti forms; and in south-western Yun-nan it is probable that the Ssi-ch'uan fauna is represented. A conclusion of special interest at which Dr. Weller arrives is that there is a mixture of North American and Baltic forms in China, as in the Himalayas, where, however, the American element seems to be stronger.

The Carboniferous fauna described by Dr. Girty from Shantung, Shan-si, and Ssi-ch'uan is very scanty and of peculiar facies, but seems remotely allied to Russian and Indian faunas, and is considered to be of Upper Carboniferous (Pennsylvanian) age, with the exception of a few very doubtful fossils. The rich Middle and Upper Carboniferous faunas described by Kayser, Loczy, Mansuy, and Deprat from other parts of China appear to be unrepresented.

F. R. C. REED.

MARINE BIOLOGY.

THE life-histories of the Pacific Coast salmon and the halibut caught off the west coast of North America form the subject of two papers just published by Dr. J. P. McMurrich in vol. vii. of the Transactions of the Royal Society of Canada. In this work the author puts the method of scale examination to a somewhat severe test. It is fairly certain that this line of investigation must be regarded only as supplementary to detailed research by means of fishery experiments and statistical studies; such is the experience of most workers in Europe. Yet Dr. McMurrich does not hesitate to describe the conclusions that may be deduced from the study of the scales of twenty-two, or ten, or even three fishes, as

"remarkably definite." The species of *Oncorhynchus* (the Pacific salmon) spawn only once in their life-times. The Pacific halibut becomes mature in its eighth year, and then enters upon a period of reproductive maturity. The ova ripen gradually, and "spawning is not a matter of a few days or even weeks, but is prolonged over, it may be, several years." This is too exceptional and improbable a result to deduce from a microscopic examination of the scales of three fishes, especially when the author admits that practically nothing is known as to the life-history of the halibut in North American waters. It is also incorrect to say that planktonic ova of this fish have not been found in European waters. Less, perhaps, is known about the halibut than most other Pleuronectids, but our ignorance is not such an utter blank as is suggested in the paper noticed.

Part i. of the Journal of the Marine Biological Association, published in November, 1913, contains papers dealing with varied aspects of marine biology. Mr. J. H. Orton, in a most useful paper, describes the functioning of the ciliary mechanisms on the gills of *Amphioxus*, *Ascidians*, and *Solenomya*. English writers, apparently accepting as correct the earlier work of Fol, have described food collection as occurring in the endostyle of *Ascidians*, the solid particles being then conducted along the peripharyngeal grooves, and so into the dorsal groove. Mr. Orton points out that no food-matter at all is taken up by the endostyle. The latter secretes mucus, which is then driven dorsally over the pharynx to the dorsal groove. Essentially the same mode of functioning of the ciliary tracts occurs both in *Amphioxus* and *Ascidians*. The pharynx in these animals, and the gills in *Lamellibranch* molluscs, are not respiratory mechanisms, but organs which function as water-pumps and food-collectors. In the same number of the journal there is an account of some very interesting experiments made by Mr. J. Gray with the object of investigating the chemical and physical changes which occur when the egg of the sea-urchin is naturally fertilised. The entrance of the sperm into the egg raises the electrical conductivity of the latter, the change attaining a maximum within ten minutes of the addition of the sperms to the ripe eggs. The egg-membrane in the unfertilised condition is remarkably impermeable to electrolytes, its surface being polarised. Probably the entrance of the sperm effects depolarisation and increases the permeability of the membrane to ions, but in some fifteen minutes polarisation again occurs, and the egg returns to its electrical state prior to fertilisation. Five other papers in the journal are written by zoologists of University College, Aberystwyth, and deal with sea-anemones, with the habits of the *Galatheidea*, and with the littoral fauna of Cardigan Bay. Dr. Th. Mortensen writes also on the development of some British Echinoderms. This number of the journal is altogether a very interesting one. J. J.

CRYSTALLINE STRUCTURES AS REVEALED BY X-RAYS.¹

THE analysis of crystal structure by means of X-rays depends on the fact that a pencil of X-rays of uniform quality is reflected by a crystal face when, and only when, it meets the face at exactly the proper angle. As we shall see presently, the effect depends on the regularity of the crystal structure according to which the atoms of the crystal are arranged in planes, which are parallel to the face and regularly spaced. There is a certain relation between

¹ From a lecture delivered before the Manchester Literary and Philosophical Society on March 18, by Prof. W. H. Bragg, F.R.S.